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The Development of Charging System Job Sheet Oriented Higher-Order Thinking Skill (HOTS) for Vocational Education

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Abstract

Job sheet system charging owned by Mechanical Engineering Education Study Program is currently only as a guide to completing the practical work. This has an impact on students' lack of knowledge to think more highly in solving a case. This research describes the design and performance analysis of the developed job sheet oriented to the Higher-Order Thinking Skills (HOTS). This type of research is Research and Development with a 4-D model. The research subjects consisted of 20 students. Data collection techniques using observation, questionnaires, and tests. Data were analyzed descriptively qualitatively and quantitatively to determine the feasibility of the job sheet. The process of developing a job sheet oriented HOTS using a 4-D model includes 4 stages namely define, design, develop, and disseminate. Job sheet feasibility test by experts to obtain results worthy of use. The developed job sheet was effectively applied in the automotive electrical practicum.

Keywords: Job sheet, Higher Order-Thinking Skill, Automotive Electric, Vocational Education

Introduction

In the process of education, ideally students can improve cognitive, affective, and skill competencies as a provision for their future lives. In order for education to be implemented in an educational unit, the learning process needs to be interactive, inspiring, fun, challenging, motivating students to participate actively, as well as providing sufficient space for initiative, creativity, and independence in accordance with their talents, interests, and physical and psychological development students (Republik Indonesia, 2003).

Mechanical Engineering Education Study Program the Faculty of Teacher Training and Education at the Universitas Sarjanawiyata Tamansiswa is a vocational education with graduates as educators, entrepreneurs, and industrial workers. In learning, adapted to the characteristics of vocational education that is oriented to the needs of the workforce (Spöttl, 2013). In order to create characteristics similar to the industrial world, the role of instructional media becomes important (Chávez Arcega & Antonio, 2010). Learning media as a substitute for learning facilities can be made cheaper and effective and efficiently studied by students.

The Mechanical Engineering Education Study Program has a learning media which is a charging system trainer kit used in the automotive electrical practicum. So that the media can be used, a job sheet is needed as a practical guide (Trianto, 2012). The charging system job sheet used in the Mechanical Engineering Education Study Program is still in the form of work steps that must be done by students. This means that with this job sheet students only follow the instructions to complete the assignment. Students are not trained in their knowledge to think higher in solving a case. Besides this, job sheet has not been used optimally by students, so there are many errors found in the steps of practicum implementation

Indonesia has experienced the effects of the development of the industrial era 4.0 which demands that 21st-century skills education alone is not enough, but must take into account the thinking capacity of students (Puncreobutr, 2016). The demand for learning skills that must be met in education is High-Older Thinking Skills (HOTS) which include creative and critical thinking (Moseley et al., 2006) (Miri, David, & Uri, 2007).

To meet these demands, it is necessary to develop a job sheet by including the HOTS element. This is expected to make it easier for lecturers to deliver the material while at the same time making it more effective and causing

interaction between lecturers and students in the learning process. With the job sheet developed, it will guide students to learn to think higher.

Job Sheet

The job sheet is an activity sheet containing instructions, steps to complete the task. Job sheet preparation in learning activities is beneficial for students in participating in learning and complements the lack of text and oral material (Prastowo, 2014)

Job sheets are called worksheets that are printed to help instructors in teaching skills, especially in laboratories (workshops) that contain instructions and drawings on how to make or complete a job. Completed job sheets include: 1) Competencies; 2) tools and accessories; 3) Work safety procedures; 4) Work steps; 5) Working drawings; and 6) Work results (Triyono, Siswanto, B, & Wagiran, 2009) (Widarto, 2019).

Job sheets serve as a guide for students to exercise the development of cognitive aspects as well as all aspects of learning in the form of an experimental or demonstration guide (Trianto, 2012). Job sheets are really needed as a reminder for students when practicum in learning and mastering one of the competencies. Job sheet development for charging system competence indirectly fixes teaching material delivered to students, so that it is expected to be able to develop the level of student thinking by entering the keyword questions from the Higher-Order Thinking Skill (HOTS)

Higher-Order Thinking Skill (HOTS)

Thinking is from the cognitive domain that Bloom classified into six cognitive levels: 1) knowledge; 2) comprehension; 3) application; 4) analysis; 5) evaluation; and 6) creation (Mainali, 2013). In cognitive levels 1 to 3 are categorized as low-level thinking abilities (LOTS), whereas cognitive levels 4 to 6 are categorized as high-level thinking abilities (HOTS) (Gunawan & Palupi, 2016).

HOTS is a process of students at a higher cognitive level that is developed through a variety of learning concepts which include problem-solving abilities, creative thinking skills, critical thinking skills, ability to reason, and the ability to make decisions (Fensham & Bellocchi, 2013). HOTS is a type of thinking that explores questions about existing knowledge related to issues that are defined abstractly (Casey, 2011). HOTS trains students to associate new information with their knowledge and then is used to find a solution to the problem.

The main aim of HOTS is to improve students' thinking skills to a higher level, especially those related to thinking critically with the information they receive and thinking creatively in solving a problem. The basic HOTS concept can be as follows (Wilson, 2016):

Table 1. Basic Concepts of HOTS

No	Level	Concept	Verbs
1	Analysis (C4)	Specifying aspects / elements	Compare, examine, criticize, test
2	Evaluation (C5)	Make your own decisions	evaluating, evaluating, refuting, deciding, choosing, supporting
3	Creation (C6)	Create ideas	Constructing, designing, creating, developing, writing, formulating

Method

The type of research used is Research and Development (R&D) with the 4D model (Thiagarajan, Semmel, & Semmel, 2016)(Thiagarajan, Semmel, & Semmel, 2016). This development model consists of 4 stages: (1) define; (2) design; (3) develop; and (4) disseminate.

The research subjects were mechanical engineering education students consisting of 20 students. The object of research is the charging system job sheet. Collection techniques using observation, questionnaires, and tests. Observation is used to determine the needs of the developed job sheet that is oriented on HOTS. The questionnaire contains a job sheet feasibility assessment by media experts, material experts, supporting lecturers, and students as users. For limited trial using 10 students and extensive trial using 20 students. Tests are used to determine the effectiveness of the job sheets developed in learning.

Data were analyzed descriptively qualitative and quantitative. Qualitative data in the form of descriptive data obtained from the results of validation by experts, the results obtained are used as a reference for product revision. Quantitative data is obtained from changing qualitative data using a Likert scale with a scale of 4 (excellent), 3 (good), 2 (enough), and 1 (less). Next, calculate the percentage of feasibility by using the formula:

$$\% = \frac{\text{Observed score}}{\text{expected score}} \text{ x } 100\%$$

the feasibility percentage is calculated by referring to table 2 to determine the feasibility criteria for the resulting job sheet (Riduwan, 2007). The minimum feasibility criteria for developing a job sheet is a minimum of "Good"

Table 2. Percentage Scale and Criteria

Percentage of Achievement	Criteria
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Enough
21 – 40%	Less
0 – 20%	Very Less

The developed job sheet is said to be effective in terms of data on student learning outcomes which include improvement in learning outcomes using the gain test formula as follows:

$$\text{N gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Ideal Skor} - \text{Pretest Score}}$$

Based on the calculation of N-gain obtained then use table 3 to determine its category. To fulfill the category of increasing learning outcomes, it must reach at least in the medium category.

Table 3. Distribution of Gain Scores

N-gain Score	Category
$g > 0,7$	High
$0,3 < g < 0,7$	Medium
$g < 0,3$	Low

Results and Discussion

Define Stage

The initial stage is defined in developing a job sheet bypassing several steps namely the initial final analysis, student analysis, task analysis, concept analysis, and learning specifications.

In the initial final analysis step, the source of the problem is found in the automotive electrical practicum process. Initial final step analysis is done by observing and interviewing a lecturer in the practice of automotive electricity. This analysis found problems in teaching lecturer using conventional methods in the form of lectures and demonstrations. Job sheets that are used in practical activities are only as a guide to completing student assignments. That is, students are guided to learn according to the procedures in the job sheet. The skill of this job sheet causes students not to be trained to think critically and creatively. Because of this, these limitations become a consideration in developing job sheets that contain material and instructions that can train HOTS for students. The developed job sheet takes the form of print media. Print media considerations in the form of job sheets because they are more efficient to be used compared to electronic media such as e-books.

In the student analysis step the findings are the lack of knowledge and skills of students in the matter of automotive electricity especially in the charging system material because of some of the competencies that exist in the course of automotive electrical practice, the most incompetent student is in the charging system section. In learning, students only assemble and overhaul the charging system without being given troubleshooting skills. Even though this troubleshooting is a very important skill in fulfilling the level 6 KKNI standards for graduates of Mechanical Engineering Education Study Program students. In level 6 students are required to have analytical skills where these skills can be realized through HOTS.

In the task analysis step, it was found that the initial job sheet used by the lecturer had not directed students to practice HOTS which was only instructions for completing practicum without analyzing material in the charging system deeper. Ideally, learning in vocational education should link real problems that occur in daily life related to the type of work. With this in mind, the job sheet that is created will be oriented to HOTS that contains C4 (synthesis/analysis), C5 (evaluation), and C6 (creative).

The concept step is carried out by looking at the syllabus/lesson plans of automotive electrical practice courses consisting of 2 practice credits. The charging system is one of the competencies that exist in automotive electrical practice courses. This competency is held twice in meetings with a 2 x 240-minute learning allocation. This competency consists of: 1) Checking the charging regulator; 2) Overhaul alternator; and 3) Assemble the charging system electricity. The specifications of the objectives to be achieved in the development of job sheets adjust the analysis of the concepts that have been prepared

Design Stage

At this stage, it is carried out with several steps, namely the preparation of instruments, media selection, and format selection.

The questionnaire was prepared as an instrument used for the feasibility test of experts including material expert and media expert. The feasibility test was also addressed to lecturers in the practice of automotive electricity and students as revised input. The feasibility test aspects for material expert and lecturer include: 1) Feasibility of contents; 2) Language; 3) Presentation; and 4) Benefits. The feasibility test aspects for media expert include: 1) Display; 2) Ease of use; 3) Consistency; 4) Format; and 5) Graphics. The feasibility test aspects for students include: 1) Presentation of material; 2) Language; 3) Graphics; and 4) Benefits.

The choice of job sheet format that was developed was in the form of print media. This is due to the ease of use and distribution in lectures. In the developed job sheet contains: 1) Competence; 2) Sub competence; 3) Tools and materials; 4) Work safety procedures; 5) Work steps; 6) Working drawings; 7) and the results of work. The work steps will include operational keywords for HOTS. The initial draft of developing a job sheet in the charging system can be seen as follows:

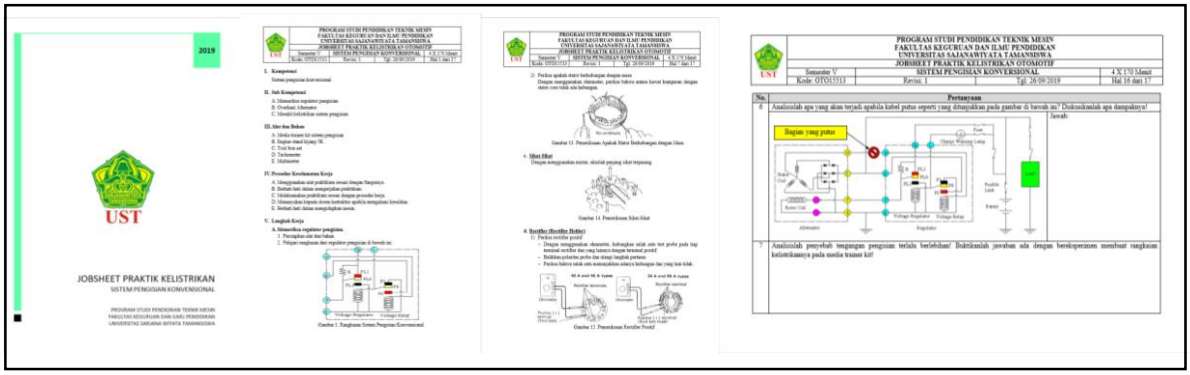

Figure 1. Initial Draft Job sheet

Development Stage

Development Phase is revising the job sheet based on inputs from material expert, media expert, lecturer, and students from the limited trial. First, input from material experts is consistency in the use of the term, especially for naming components. Second, input from media experts, namely unclear pictures and the need for coloring so that the job sheet is more attractive. Third, input from supporting lecturers is the need to add a basic theory of charging system. Fourth, the input from the limited group trial is the need for an explanation in the name of the component in a foreign language so that it is not confusing for students. Based on these inputs, the job sheet was then revised in terms of consistency in terms of terms and information in foreign languages, especially for component names. A theoretical study was added as a basis for charging system theory. Then the next job sheet is colored in parts of the subtitles to make it interesting.

The feasibility test data was collected by using a questionnaire instrument. Job sheet eligibility exams are analyzed based on the results of the assessment by material expert, media expert, lecturer, and responses from students on limited trials. Job sheet eligibility results are feasible to use if it is in the "Good" minimal category. Job sheet feasibility test results developed with HOTS orientation can be seen as follows:

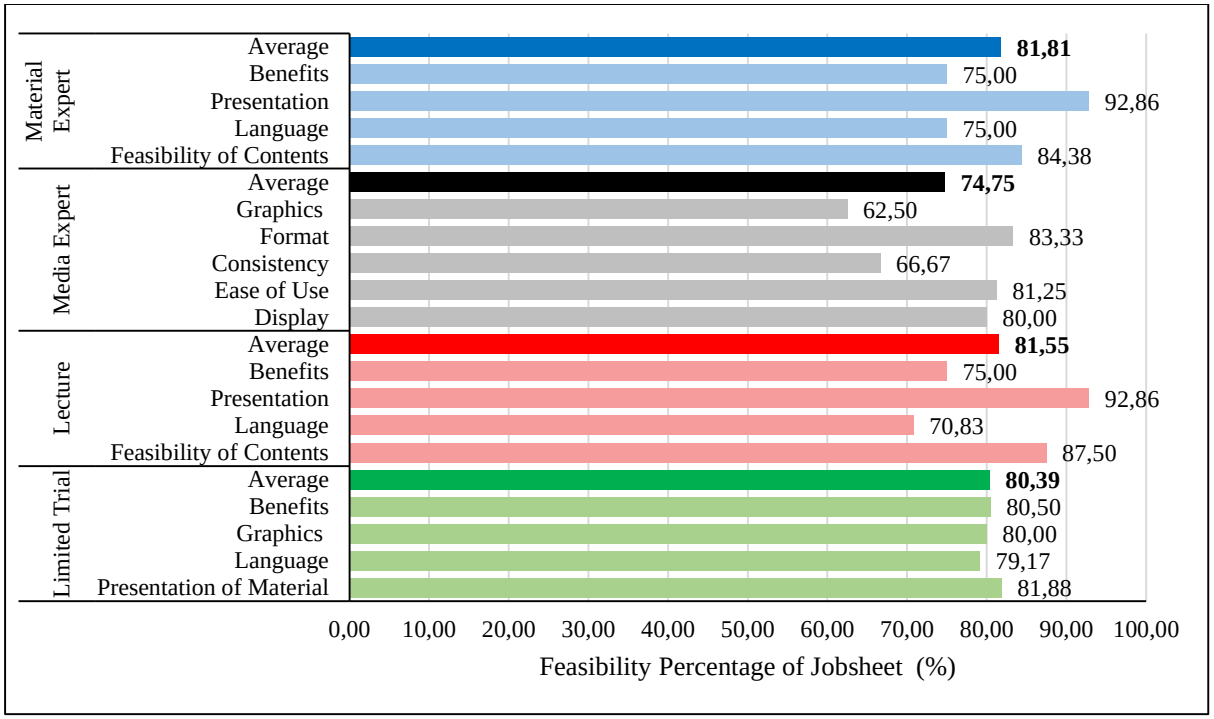

Figure 2. Job Sheet Feasibility Results by Material Expert, Media Expert, Lecturer, and Limited Trial

The results of the assessment of the feasibility of job sheet by material expert on aspects of benefit were 75% including good category, presentation aspects of 92.86% including very good category, language aspect of 75% including good category, the feasibility of contents aspect of 84,38 including very good category. Overall, of the four aspects, it obtained a result of 81.81% including very good category.

The results of the assessment of the feasibility of job sheet by media expert on aspects of graphics were 62,5% including good category, format aspects of 83.33% including very good category, consistency aspect of 66,67% including good category, ease of use aspect of 81,25 including very good category, display aspect of 80%. Overall, of the five aspects, it obtained a result of 74.75% including good category.

The results of the assessment of the feasibility of the job sheet by lecture on aspects of benefit were 75% including good category, presentation aspects of 92.86% including very good category, language aspect of 70,83% including good category, feasibility of contents aspect of 87,50% including very good category. Overall, of the four aspects, it obtained a result of 81.55% including very good category.

The results of the assessment of the feasibility of job sheet by limited trial on aspects of benefit were 80,50% including good category, graphics aspects of 80% including good category, language aspect of 79,17% including good category, presentation of material aspect of 81,88% including very good category. Overall, of the four aspects, it obtained a result of 80.39% including good category.

Disseminate Stage

At this stage, the job sheet is ready to be printed and distributed to students as an extensive trial. The results of the expanded trial can be seen as follows:

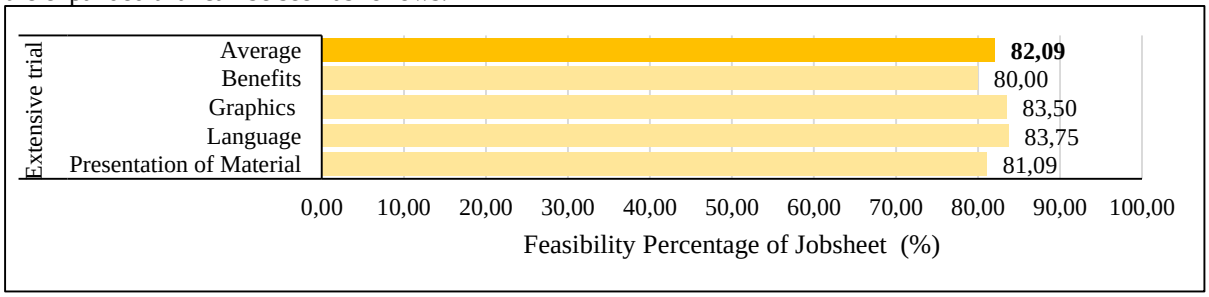

Figure 3. Job Sheet Feasibility Results by Extensive Trial

The results of the assessment of the feasibility of job sheet by extensive trial on aspects of benefit were 80,00% including good category, graphics aspects of 83,50% including very good category, language aspect of 83,75% including very good category, presentation of material aspect of 81,09% including very good category. Overall, of the four aspects, it obtained a result of 82.09% including very good category.

The job sheet effectiveness test uses 2 types of data, namely pretest, and posttest. The results of the pretest and posttest can be seen as follows:

Table 4. Pretest and Posttest Score Results

Score	The Number of Students	Min.	Max.	Mean	Standard Deviation
Pretest	20	27	76	51	12,62
Posttest	20	61	88	72,9	7,50

From the results of the pretest and posttest scores, the effectiveness test can be calculated using the gain test with the results of 0.45 including the medium category. These results indicate that the job sheet charging system oriented HOTS that was developed was effectively used in lectures.

Job sheets are one of the learning media that can effectively the learning process (Handoyono & Hadi, 2018). Job sheets that are arranged with HOTS orientation are suitable for vocational education because they are schools that prepare graduates to work in certain fields, therefore in their learning, they always encounter problems in their fields (Hanushek, Schwerdt, Woessmann, & Zhang, 2017). In learning students need to be trained in solving cases in accordance with their fields which include problem-solving skills, making decisions, thinking about crises, and thinking creatively. The application of job sheet oriented HOTS is very appropriate to practice those skills because the developed job sheets contain HOTS verbs at levels C4 to C6. With this verb, students can prove their ideas in experimenting in problem-solving. HOTS development for students is recommended in practicum learning (Chinedu & Kamin, 2015).

Conclusion

The process of developing a charging system job sheet oriented HOTS using a 4-D model includes 4 stages: define, design, develop, and disseminate. Job sheet feasibility test by experts to obtain results worthy of use. The developed job sheet is effectively applied in the automotive electrical practicum.

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References

Casey, G. (2011). Thinking critically about critical thinking. In *Critical Thinking and Higher Order Thinking: A Current Perspective*. New York: Nova Science Publishers, Inc.

Chávez Arcega, & Antonio, M. (2010). Instructional technology and media for learning. *Revista Mexicana de Investigación Educativa*, *15*(44), 191–196.

Chinedu, C. C., & Kamin, Y. (2015). Strategies for Improving Higher Order Thinking Skills in Teaching and Learning of Design and Technology Education. *Journal of Technical Education and Training*, *7*(2), 35–43.

Fensham, P. J., & Bellocchi, A. (2013). Higher order thinking in chemistry curriculum and its assessment. *Thinking Skills and Creativity*, *10*, 250–264. https://doi.org/10.1016/j.tsc.2013.06.003

Gunawan, I., & Palupi, A. R. (2016). Taksonomi bloom – revisi ranah kognitif: kerangka landasan untuk pembelajaran, pengajaran, dan penilaian. *Premiere Educandum: Jurnal Pendidikan Dasar Dan Pembelajaran*, *2*(2), 98–117. https://doi.org/10.25273/pe.v2i02.50

Handoyono, N. A., & Hadi, S. (2018). Pengembangan modul pembuatan bodi kendaraan dari fiberglass untuk mendukung Perkuliahan cat dan bodi Kendaraan. *Taman Vokasi*, *6*(1), 36–44. Retrieved from http://jurnal.ustjogja.ac.id/index.php/tamanvokasi/article/view/2818

Hanushek, E. A., Schwerdt, G., Woessmann, L., & Zhang, L. (2017). General education, vocational education, and labor-market outcomes over the lifecycle. *Journal of Human Resources*.

https://doi.org/10.3368/jhr.52.1.0415-7074R
Mainali, B. P. (2013). Higher order thinking in education. *Academic Voices: A Multidisciplinary Journal*, *2*(1), 5–10. https://doi.org/10.3126/av.v2i1.8277
Miri, B., David, B. C., & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in Science Education*, *37*(4), 353–369. https://doi.org/10.1007/s11165-006-9029-2
Moseley, D., Baumfield, V., Elliott, J., Gregson, M., Higgins, S., Miller, J., & Newton, D. (2006). Frameworks for thinking: A handbook for teaching and learning. In *Frameworks for Thinking: A Handbook for Teaching and Learning*. https://doi.org/10.1017/CBO9780511489914
Prastowo, A. (2014). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. https://doi.org/10.1016/j.burns.2014.02.013
Puncreobutr, V. (2016). Education 4.0: New Challenge of Learning. *Humanitarian and Socio-Economic Sciences*, *2*(2), 92–97.
Republik Indonesia. (2003). Undang-Undang Sistem Pendidikan Nasional No. 20 Tahun 2003. *Sekretariat Negara*. https://doi.org/10.16309/j.cnki.issn.1007-1776.2003.03.004
Riduwan. (2007). *Skala Pengukuran Variabel-variabel Penelitian*. Bandung: Alfabeta.
Spöttl, G. (2013). Permeability between VET and higher education - a way of human resource development. *European Journal of Training and Development*, *37*(5), 454–471. https://doi.org/10.1108/03090591311327286
Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (2016). *Instructional development for training teachers of exceptional children: A sourcebook*. https://doi.org/10.1016/0022-4405(76)90066-2
Trianto. (2012). *Mendesain Model Pembelajaran Inovatif Progresif*. Jakarta: Kencana Prenada Media Group.
Triyono, M. B., Siswanto, B, T., & Wagiran. (2009). *Materi Diktat Training of Trainer Calon Tenaga Pengajaran/ Dosen Lingkungan Badiklat Perhubungan*. Magelang: Badan Diklat Departemen Perhubungan.
Widarto. (2019). Panduan Penyusunan Jobsheet Mapel Produktif Pada SMK. Retrieved from https://dokumen.tips/documents/panduan-penyusunan-jobsheet-mapel-produktif-pada-smk.html
Wilson, L. O. (2016). Anderson and Krathwohl - Understanding the New Version of Bloom ' s Taxonomy The Cognitive Domain : Anderson and Krathwohl - Bloom ' s Taxonomy Revised. Retrieved from A succinct discussion of the revisions to Bloom's classic cognitive taxonomy by Lorin Anderson and David Krathwohl and how to use them effectively website: https://thesecondprinciple.com/teaching-essentials/beyond-bloom-cognitive-taxonomy-revised/

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